



# Effect of a Multimodal Exercise Program on Balance and Functional Ability of Rural Elderly

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## Abstract

**Background:** Balance is commonly used to describe stability and steadiness when older adults are standing or sitting. As well, functional status refers to a person's ability to perform tasks that are required for living as eating, bathing and dressing. Aim: The present study aimed to evaluate the effect of a multimodal exercise program on balance and functional ability of rural elderly. Setting: The study was conducted at Kafar El Shiekh Mosa Amran, Zagazig District, Sharkia Governorat. Egypt. Sample: A purposive sample of 60 older adults who fulfilled the inclusion criteria. Tools: three tools were used; Tool I was a structured interview questionnaire to assess elderly demographic characteristics and medical history, tool II was the Performance Oriented Mobility Assessment (POMA B scale) and tool III was The Lawton instrumental activities of daily livings (IADLs) scale. Results: The study revealed that functional ability scores increased from 6.7±.70, 3.6±.51 to 7.7±.63 and 4.3±.72 among studied older women and studied older men respectively. As well, the mean score of balance increased from 8.57±3.0 to 13.85 ± 2.5 post program. These difference were statistically significant (P=000) which indicates statistically significant improvement in older adults functional ability and balance post the program. Conclusion: The multimodal Exercise program is effective in increasing the elderly's functional ability and balance. Recommendations: The multimodal Exercise program can be used as an effective non pharmacological intervention to improve older adult's functional ability and balance.

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**Keywords:** Multimodal Exercise Program, Balance, Functional Ability, Rural Elderly

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## Introduction

According to World Population Prospects 2019, by 2050, 1 in 6 people in the world will be over the age of 65, up from 1 in 11 in 2019. Population ageing is a global phenomenon: Virtually every country is experiencing growth in the size and proportion of older persons in their population. There were 703 million persons aged 65 years or over in the world in 2019. The number of older

persons is projected to double to 1.5 billion in 2050 (United Nations, 2019). In Egypt, the number of older adults aged 60+ years reached 7.63 million; 3.80 million males and 3.82 million females, accounting for 7.6 % of the total population according to the Central Agency for Public Mobilization and Statistics [CAPMAS] (CAPMAS, 2020).



Balance is defined as the ability to keep your body centered over your feet. This is accomplished by coordinating inputs from the vestibular, visual, and proprioceptive systems. It is usually divided into two types of balance: static and dynamic. Static balance is defined as the ability to maintain an upright trunk position against gravitational forces or outside perturbations. It is the ability to support the body in a state of equilibrium. Dynamic balance is defined as the ability to move from position to position without falling or the ability to return to a more stable position, change direction and continue to move in a coordinated and smooth manner (Dunsky et al., 2017).

Balance is a critical component of most activities of daily living among older adults. Good balance reach older adults living independently, productively, and proactively in housework, cooking, shopping, and travel. Maintenance of a balanced independence is essential for staying healthy and for well-being. Poor balance is a major risk factor for falls, a leading cause of hospitalization and many negative outcomes (Thiamwong and Suwanno, 2014). Balance disorders markedly increases with age, from around 10 % between the ages of 60 and 69 years to more than 60 % in those over 80 years. Balance impairments may greatly affect the quality of life and restrict the personal independence of those affected (Mahlknecht et al., 2013).

The term functional inability is defined as “difficulties that substantially interfere with or limit role functioning in one or more major life activities including the following: daily activities of daily living (ADL) (e.g., eating, bathing, dressing); instrumental activities of daily living (IADL) (e.g., maintaining a household, managing money, getting around the community, taking prescribed medication) and functioning in social, family, and vocational/educational contexts (Sedam, 2015).

Advanced age is accompanied by a number of cellular and molecular dysfunctions that are

responsible for a progressive loss of physical and cognitive function. Moreover, functional decline and disability become progressively more frequent and strongly impact older adult’s health (Vetrano et al., 2018).

Gerontological nurses maintain functional abilities through helping with moving and walking, encouraging autonomy and offering assistance according to abilities, relieving pain prior to activities requiring moving, monitoring, and instructing not to get up or walk alone to prevent falls, improving nutrition and hydration, maintaining urinary continence, and sleep quality interventions. Therefore, the nursing care team must have specific criteria as respect for older adult’s decisions, attention, and patience to maintain functional abilities and autonomy for older adults (Lafrenière et al., 2017).

### **Aim of the study**

The aim of the current study was to evaluate the effect of a multimodal exercise program on balance, functional ability of rural elderly.

### **This aim was fulfilled through the following objectives: -**

1. Assess balance of older adult’s pre and post a multimodal exercise program.
2. Measure functional ability of older adult’s pre and post a multimodal exercise program.
3. Develop and implement a multimodal exercise program to improve balance and functional ability.
4. Evaluate the effect of a multimodal exercise program on balance, functional ability.

### **Research hypothesis:**

1. Balance of older adults will be improved after implementation of a multimodal exercise program.



2. Functional ability of older adults will be increased after implementation of a multimodal exercise program.

- Bedridden older adults.
- Older adults with psychiatric diseases.
- Older adults receiving physiotherapy sessions.

## Subjects and Methods

### Study Design and Ethical Considerations

A quasi-experimental design was used to conduct the current study. The fieldwork was carried out within the period of six months, starting from the beginning of March 2021 up to the end of August 2021 at Kafar El shiekh Mosa Amran, Zagazig District, Sharkia Governorat, Egypt. The study was approved by the Research Ethics Committee (REC) and the Postgraduate Committee of the Faculty of Nursing at Zagazig University, Egypt. Verbal consent was obtained from the rural elderly after a description of the purpose of the study.

### Setting:

The study was conducted at Kafar El shiekh Mosa Amran, Zagazig District, Sharkia Governorat, Egypt.

### Sample:

A purposive sample was used in this study that comprised of 60 older adults

The older adults participated in the current study were fulfilled the following criteria

- Able to move and perform activity of daily living .
- Able to cooperate and agree to participate in the study .
- Free from communication problems (speech and hearing problems)

### Exclusion criteria:

- Older adults have any health disorder that might affect balance and (Parkinsonism and paralysis)

### Sampling technique

A Multistage cluster sampling technique was used in the recruitment of this study subjects as follows :

- First stage (selection of district): The study was conducted in Sharkia Governorate, which consists of 13 districts. The investigator used simple random sampling technique to pick up a random district, it was Zagazig district (consists of 75 villages).
- Second stage (selection of village): The investigator picked up one village from the 75 villages randomly (Kafar El Sheikh Mosa Amran).
- Third stage (selection of elderly people): The selected village was divided into 17 clusters. From each clusters four streets were selected randomly.

All the elderly people in the selected clusters were included in the study sample till reaching the calculated sample size.

### Tools of Data Collection:

Three tools were used to collect necessary data. **Tool I:** A structured interview questionnaire that was developed by the researcher after reviewing the related literature. It composed of two parts; It composed of demographic characteristics which entails data about demographic characteristic of the study sample such as; age, sex, marital status, educational level, current occupation, monthly income and two questions about having chronic diseases such as: diabetes, hypertension, gastrointestinal diseases, respiratory diseases, renal diseases, cardio-



vascular diseases, liver diseases arthritis and osteoporosis ...etc and medications.

**Tool II:** The Performance Oriented Mobility Assessment (POMA B scale): This questionnaire was developed by (Tinetti, 1986) in order to determine balance of older adults. It consisted of 9 questions. The Balance related items were (sitting balance, arises, attempts to arise, immediate standing balance, standing balance, nudged, eyes closed, turning 360°, and sitting down).

#### **Scoring system:**

These questions evaluated on three point ordinal scale, ranging from 0-2. "0" indicates the highest level of impairment and "2" the older adult's independence. The total score for the balance component is 16 points, with higher scores indicating better balance.

**Tool III:** The Lawton instrumental activities of daily livings (IADLs) scale which was developed by Lawton and Brody (1969) to assess the ability to perform the functioning tasks independently. The component of this index are highly ordered allowing for gradual loss of independence in the order of ability to use telephone, shop, prepare food, housekeeping, laundry, use transportation, take medications and handle own finances.

#### **Scoring system:**

The scale examines eight different activities, namely ability to use the phone, shop, prepare food, housekeeping, laundry, use transportation, responsibility for own medication and ability to handle finances. Each of the functions is measured and scored according to the older adult's actual performance according to the level of ability, which ranges from 3 to 5 categories. For each function, the older adults is asked to select the option that most closely resembles her corresponding highest functional level, either 0

or 1. Older Women are scored on all 8 areas of function. The scores of the eight items are summed up for a total score that ranges from 0 (low function, dependent) to 8 (high function, independent). For men, the areas of food preparation, housekeeping, laundering are excluded. Older men are scored according to their highest level of functioning in that category (0 low functions, dependent) to 5 (high function, independent). Older women with a total score of 7 or higher was considered able to perform the daily life functions effectively, whereas an older women with lower score was considered unable. While older men with a total score of 4 or higher was considered able to perform the daily life functions effectively, whereas an older men with lower score was considered unable.

#### ***The multimodal exercise program***

It was implemented in the study setting in the form of nine sessions for small groups (4 to 5 older adults). This was intended to give more chance for discussions, interactions, and practical training. The total sample was divided into small groups (4 to 5 older adults in each group). All groups received the same content using the same teaching methods, media (as point presentations, posters, and pictures), discussions, and the same booklet.

#### ***The following nine sessions were held for all older adults***

##### **Session 1: (Time: 45 minutes)**

The main objective of this session was to improve older adult's knowledge about aging, the age physiological changes, definition of functional ability, the etiology of functional inability, assessment methods of functional ability in older adults and consequences of functional inability and enhance older adult's knowledge about definition of balance, etiology of balance disorders, symptoms, consequences, physiology of balance disorders and its assessment methods.



### Session 2: (Time: 30 minutes)

The main objective of this session was to help the older adults to identify exercise, types of exercise, and health benefits of exercise and recommendations of exercise in older adults .

### Session 3: (Time: 30 minutes)

The main objective of this session was to help the older adults perform heel to toe exercise correctly .

### Session 4: (Time: 30 minutes)

The main objective of this session was to help the older adults perform the sideways walking exercise correctly.

### Session 5: (Time: 30 minute)

The main objective of this session was to help the older adults perform stand on one leg exercise correctly.

### Session 6: (Time: 30 minutes)

The main objective of this session was to help the older adults perform sit to stand exercise correctly.

### Session 7: (Time: 30 minutes)

The main objective of this session was to help the older adults perform side arm raises exercise correctly.

### Session 8: (Time: 30 minute)

The main objective of this session was to help the older adults perform knee extensions exercise correctly.

### Session 9: (Time: 30 minute)

The main objective of this session was to help the older adults perform standing harm string curls exercises, shoulder and upper arm stretching exercises correctly.

### Statistical design:

Data entry and statistical analysis were done using SPSS 23.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the study scales through their internal consistency. Quantitative continuous data were compared using the non-parametric Mann-Whitney or Kruskal-Wallis tests and paired t test. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors balance and functional ability, multiple linear regression analysis was used and analysis of variance for the full regression models was done. Statistical significance was considered at p-value <0.05. Pearson correlation was used for assessment of the interrelations among the study scales.

### Results

Table 1 reveals that the older adults' age ranged between 60 and 83 years, with mean  $68.2 \pm 6.2$  years, with more females (75%). In addition, 68.3% of the studied older adults were married and illiterate and 83.3% of them weren't working currently. Furthermore, 71.7% of the studied older adults had sufficient income. 66.7% of the studied older adults were having chronic diseases. As well as, 56.7% of them were on regular medication.

Table 2 clarifies the mean score of balance test increased from  $8.57 \pm 3.0$  in the pretest to  $13.85 \pm 2.5$  in the post test. The difference was statistically significant (P=000) which indicates statistically significant improvement in older adults balance post the program.



Regarding total means score of functional ability categories pre and post a multimodal exercise program, table 3 reveals that  $6.7 \pm 0.70$  and  $3.6 \pm 0.51$  were total mean score of the studied older women and studied older men before the program which increased to  $7.7 \pm 0.63$  and  $4.3 \pm 0.72$ , respectively after the program. These improvements were highly statistically significant.

The table 4 also indicates a statistically significant positive correlation between women's functional ability score and balance score {the higher the score of functional ability of older women, the higher balance score} ( $r=0.443$ ).

Table 5 shows that age, unmarried status and disease number had statistically significant negative correlation with balance score. Meanwhile, having no chronic disease and taking medication regularly had statistically significant positive correlations with balance score. Concerning men's functional ability, this score had statistically significant positive correlations with having no chronic disease and taking medication regularly. As well, this score had a statistically significant negative correlation with no current occupation. As regard for women's functional ability score, this score had statistically significant negative correlation with age, unmarried status and disease number. However, this score had a statistically significant positive correlation with taking medication regularly as in table 5.

### **Discussion:**

According to study results the studied older adults reported decreased balance before the program (with total mean score =  $8.57 \pm 3.0$ ) but after implementation of the current study multimodal exercise program, there were statistically significant improvements in older adults balance mean scores (with total balance mean score =  $13.85 \pm 2.5$ ,  $P=0.000$ ). This might be attributed to the effectiveness of the training program and continuity of training. As well as, application of

different kinds of exercises focusing on different muscles at one time. Correspondingly, the studies conducted in Turkey by Dizdar et al., (2018) assured that there were statistically significant improvements in exercise group rather than control group. Another study conducted in Denmark by Ehrari et al., (2020) stated that the exercise group participants improved balance score by an average of 5.02 point and the control group by 2.58 points.

Pre- the multimodal exercise program, the studied older adults were already independent in activities of daily living (total mean score for elderly women =  $6.7 \pm 0.70$ , total mean score for elderly men =  $3.6 \pm 0.51$ ). This might be attributed to according inclusion criteria of the study, the studied older adults should be able to participate in the multimodal exercise program and independent in activities of daily living.

As well, after implementation of a multimodal exercise program, the results demonstrated significant acceptable improvement in activities of daily living (total mean score for elderly women =  $7.7 \pm 0.63$ , total mean score for elderly men =  $4.3 \pm 0.72$ ). This might be attributed to strengthen muscles by exercising make performing activities of daily living more easier. These results correspond with the results of Scarabottolo et al., (2017) in Brazil who found that there was a statistical significant improvement in functional capacity in exercise groups. These improvements were in the following functional tests: upper limb strength (exercise group  $15.6 \pm 4.1$  x control group  $10.7 \pm 6.6$ ,  $p < 0.05$ ) and chair lift test (exercise group  $11.0 \pm 4.0$  x control group  $8.0 \pm 3.1$ ,  $p < 0.05$ ). Another study done by Martínez-Velilla et al., (2019) in Spain designed that the control group received usual care (daily routine), the intervention group received individualized exercises. The exercise intervention program provided significant benefits over usual care ( $P=0.000$ ) as the mean score of Barthel Index (scale of functional ability) in the control group was (-3.2) compared to exercise group (3.7).



Concerning the correlation of functional ability, the current study revealed that there was a statistically significant positive correlation between women's functional ability score and balance score {the higher the score of functional ability of older women, the higher balance score}( $r=0.443$ ). This might be due to that both balance and functional ability are associated by muscles strength that were already improved by exercises so, they were positively correlated. These results go in the same line with finding of Tomás et al., (2018) in Portugal who demonstrated that there was significant association between functional ability mean score and balance mean score as (the balance mean score was  $46.29 \pm 6.54$  among dependent in ADL group compared to  $53.46 \pm 2.69$  among independent group).

As well as, the current study revealed that there were a negative correlation between age and functional ability of older women. This may be attributed to that physical functioning diminishes with age and the speed of deterioration accelerates among older adults. Similarly, results of Ghimire et al., (2021) in Eastern Nepal noted that old age was strong factor associated with poor functional status. The binary logistic regression model explained that oldest age group ( $\geq 80$  years) had an increased likelihood of poor functioning than other younger old groups.

There were statistically significant negative correlations between ages mean score and balance mean score (the higher age, the lower balance mean score). This might be attributed to these studied older adults lived at rural areas and were confined to closed environments with limited social interactions. These environmental restrictions, coupled with chronic diseases that grow gradually with aging, would have caused older adults to be vulnerable to reduced physical activity and reduced balance. This is the same opinion of Wickramarachchi et al., (2021) in Sri Lanka who stated that age is a vital determinant of inactivity and loss of balance among older adults.

## **Conclusion**

Based upon the findings of the present study and answer of hypothesis, it can be concluded that pre the multimodal exercise program the studied elderly had decreased balance and decreased functional ability and the applied multimodal exercise program was effective in increasing studied elderly balance and functional ability.

## **Recommendations**

In view of the current study findings, the multimodal Exercise program can be used as an effective non pharmacological intervention to increase older adults balance and functional ability. The multimodal exercise program should be implemented in the study setting on a long term basis and in similar setting to confirm its effectiveness. Moreover, replication of the study using a larger probability sample from different urban areas to help for generalization of the results.

## **Declaration of Conflicting Interests**

The author declares that there is no conflict of interest.

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Table 1: Demographic characteristics of the studied elderly (N=60)

Demographic characteristics	(n=60)	
	Frequency	Percent
<b>Age group: /year</b>		
60 < 70	38	63.3
70 < 80	16	26.7
≥ 80	6	10.0
<b>Mean ± SD (range)</b>	<b>68.2 ± 6.2 (60 – 83)</b>	
<b>Gender:</b>		
Male	15	25.0
Female	45	75.0
<b>Marital status:</b>		
Married	41	68.3
Widower/ divorced	19	31.7
<b>Education:</b>		
Illiterate	41	68.3
Read & write& basic education	15	25.0
Intermediate education	4	6.7
<b>Current occupation:</b>		
Working	10	16.7
Not working	50	83.3
<b>Monthly Income:</b>		
Sufficient	43	71.7
Insufficient	17	28.3
<b>Have chronic diseases:</b>		
Yes	40	66.7
No	20	33.3
<b>On regular medication</b>		
Yes	34	56.7
No	26	43.3

Table (2): Total mean score of Performance Oriented Mobility Assessment (POMA B scale) among the studied older adults throughout the study phases (n=60)

Performance Oriented Mobility Assessment	Pre (n=60)	Post (n=60)	t-test	(p-value)
	Mean ± SD	Mean ± SD		
Balance tests mean score (POMA B) Out of 16	8.57±3.0	13.85 ± 2.5	18.65	.000**





Table (3): Total means score of functional ability pre and post a multimodal exercise program

Functional ability scores	Pre (n=60)	Post (n=60)	t-test	(p-value)
	Mean ± SD	Mean ± SD		
Total mean score for elderly women (8)	6.7±.70	7.7±.63	30.75	.000**
Total mean score for elderly men (5)	3.6±.51	4.3±.72	7.48	.000**

Table (4): Correlation between older adults' total mean score of balance and functional ability scores

scores	Total mean scores		
	Balance	Men's Functional ability	Women's Functional ability
Balance		.009	.443**
Men's Functional ability	.009		
Women's Functional ability	.443**		

Table (5): Correlation between balance and functional ability scores post the program and older adults' characteristics

scores	Total mean scores		
	Balance	Men's Functional ability	Women's Functional ability
Age	-.457**	-.241	-.756**
Marital status [unmarried]	-.325**	-.169	-.452**
Current occupation [not work]	-.133	-.727**	-.142
Had chronic diseases [no]	.323*	.603*	.273
Disease number	-.322*	.401	-.632**
Taking medication regularly [yes]	.359**	.727**	.370*
Number of falls	-.058	-.409	-.014



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